



DECLARATION

Re: US patent application 09/857606

I, Magnus Limbäck, M.Sc. in Engineering Physics, employed at Westinghouse Electric Sweden AB and there responsible for BWR fuel material, make the following declaration.

I.

I have previously made a declaration, signed by me on 22 June 2004, in this case.

I have now noticed that the declaration contains typing errors in connection with Figure 3. These errors are that the same alloy (Zr1.5Nb0.5Sn0.3Fe) has been entered twice in the legend to the right of the figure and twice in the rectangles pointing to the figure itself.

I here below, on the next page, enclose a corrected Figure 3. The places where the figure has been corrected are marked by arrows pointing to the corrected entries.

When further below in this declaration Figure 3 is mentioned, it is being referred to the corrected Figure 3. When Figures 1 and 2 are mentioned, it is being referred to these Figures in the previous declaration.

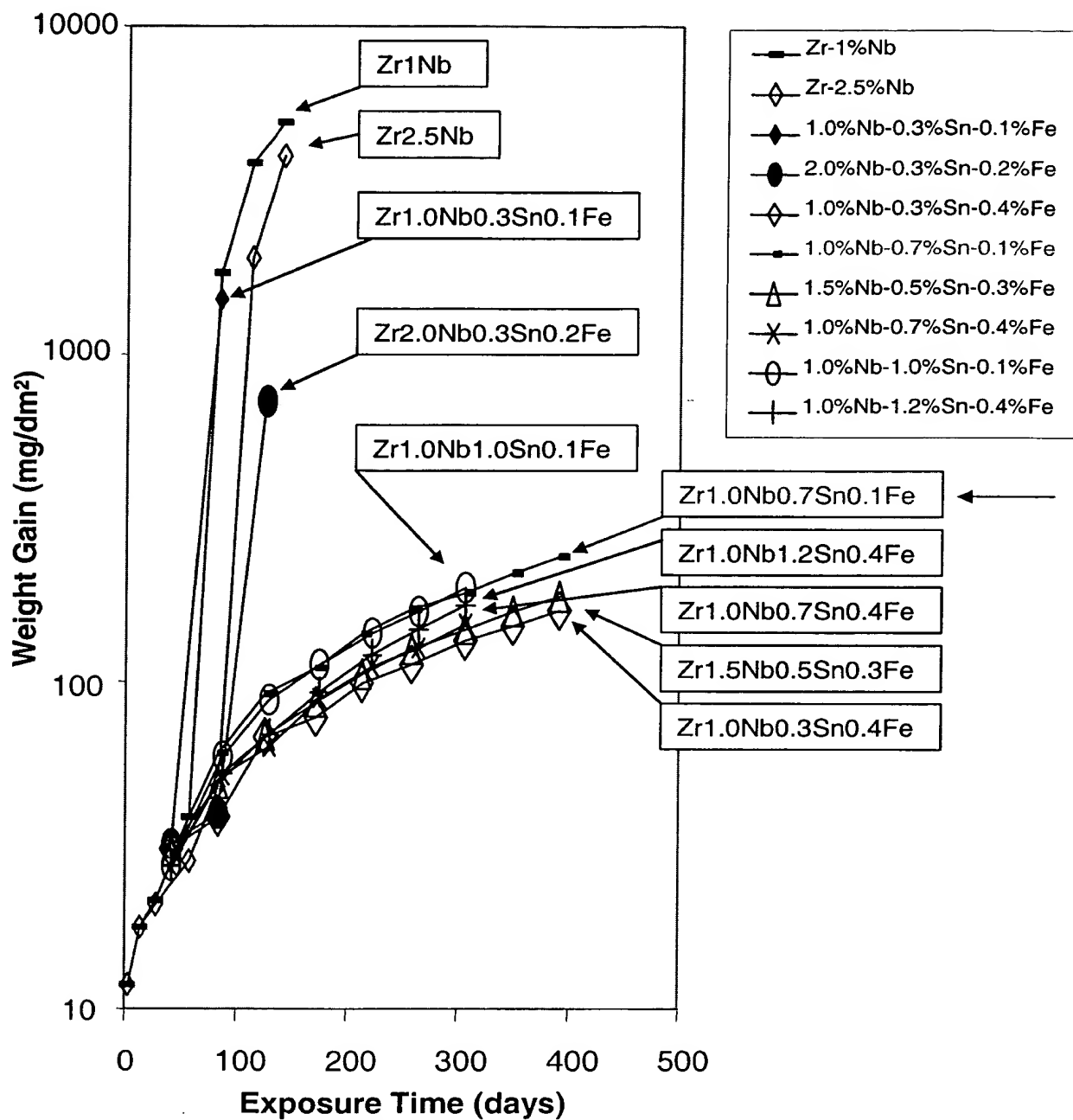


Figure 3: Long term corrosion test of coupons in 70 ppm lithiated water at 633 K.

II.

In addition to the to the statements made above, and in the previous declaration, I hereby add the following.

The results from the 633 K pure water (Fig. 2) and the 700 K steam (Fig. 1) tests indicate that the Sn concentration should be as low as possible within the studied interval to optimize the corrosion resistance in these environments. On the other hand, Fig. 3, which presents the results from the 633 K 70 ppm lithiated water tests, shows two classes of materials, one that is sensitive to Li-induced acceleration of the corrosion rate and one that is almost immune against this type of acceleration. For the inventors of the product described in the current patent application it has been important to assure that the newly developed material will belong to the second improved group.

It is, thus, of special interest to compare the results for four of the materials included in Fig. 3, Zr1.0Nb0.3Sn0.1Fe , Zr1.0Nb0.7Sn0.1Fe , Zr1.0Nb0.3Sn0.4Fe and Zr1.0Nb0.7Sn0.4Fe . The first of these four materials experiences Li-induced acceleration of the corrosion rate, while the latter three have very good resistance against such acceleration. It is concluded that the difference in performance between these alloys is due to the difference in chemical composition. The alloy with poor corrosion resistance has low Sn (0.3 wt%) and low Fe (0.1 wt%) contents, while the alloys with very good resistance have higher Sn (0.7 wt%) and/or higher Fe (0.4 wt%) concentrations. The data, consequently, shows that the corrosion resistance is improved by increasing the Sn concentration from 0.3 to 0.7 wt% and by increasing the Fe content from 0.1 to 0.4 wt%.

The effect of Sn and Fe concentration on the corrosion performance is further elucidated by plotting subsets of the data presented in Fig. 3. Figure A, consequently, depicts the weight gain measured after 84 days as a function of Sn concentration for $\text{Zr1.0Nb}x\text{Sn0.1Fe}$ type materials. This graph shows the significant improvement in corrosion resistance that is gained by increasing the Sn content from 0.3 to 0.7 wt%. Figure B, furthermore, shows the beneficial effect of increasing the Fe concentration in $\text{Zr1.0Nb0.7Sn}x\text{Fe}$ type materials that is observed after 307 days.

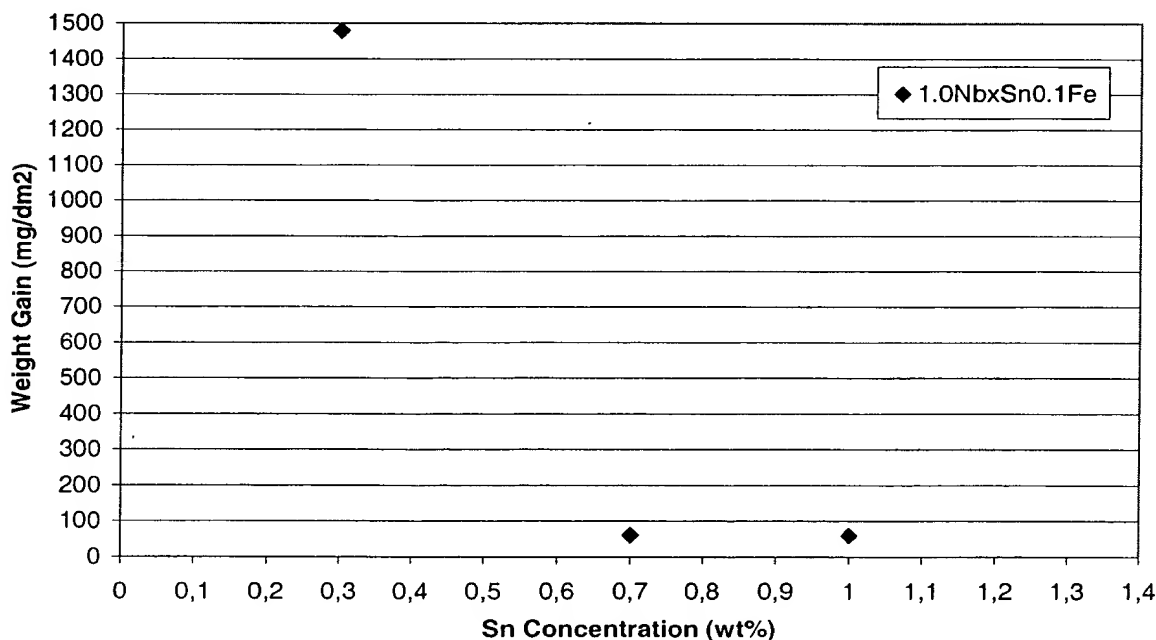


Figure A: Weight gain as a function of Sn content for $\text{Zr1.0Nb}x\text{Sn0.1Fe}$ type materials after 84 days exposure at 633 K in 70 ppm lithiated water.

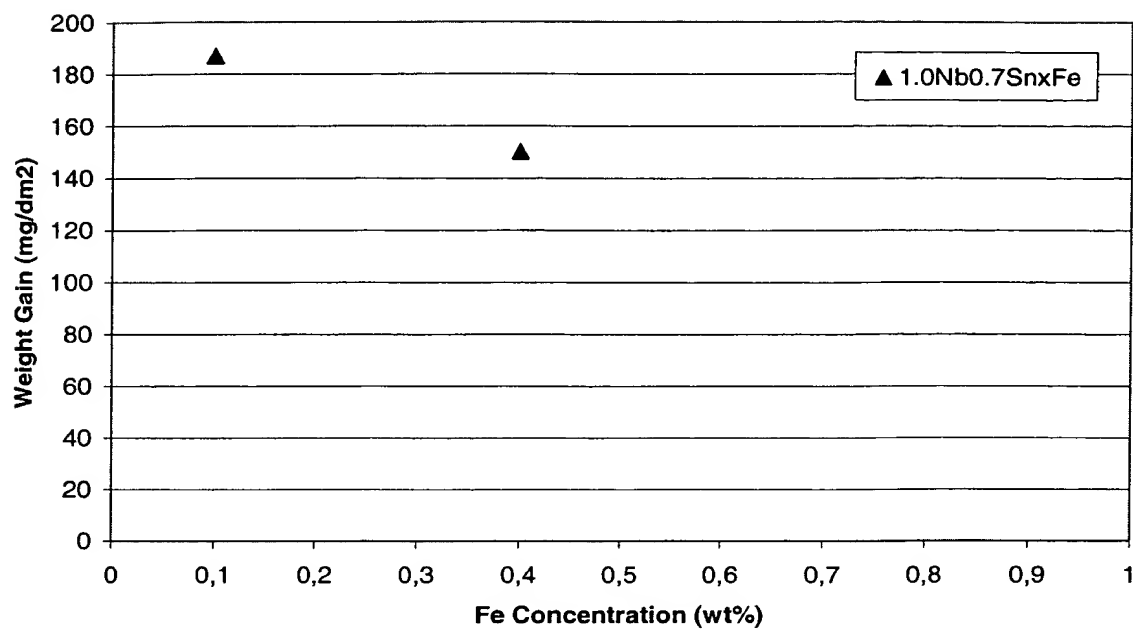


Figure B: Weight gain as a function of Fe content for Zr1.0Nb0.7SnxFe type materials after 307 days exposure at 633 K in 70 ppm lithiated water.

The goal of the current development is an alloy that is robust and has very good corrosion resistance not only in autoclaves but also, and more importantly, in various types of in-reactor environments. The inventors have applied a redundant approach where the two improving factors, i.e., increased Fe and Sn concentrations, are combined. The inventors have, consequently, chosen an alloy with >0.65 wt% Sn in combination with >0.30 wt% Fe.

In addition to the test results presented earlier a corrosion test has also been made in steam at 415°C (688 K). The results are presented in Fig. C and show that decreasing the Sn content from 1.14 to 0.95 drastically improves the corrosion resistance. The data, moreover, show that decreasing the Sn content to 0.8 wt% further improves the corrosion resistance, but that the material with 0.65 wt% Sn has about the same corrosion resistance as the material with 0.8 wt% Sn. These observations are all valid for materials with 0.32-0.35 wt% Fe. When comparing the two materials with 0.65-0.67 wt% Sn it can be observed that the material with the higher Fe content (0.35 wt%) has somewhat better corrosion resistance than the material with lower Fe concentration (0.10 wt%).

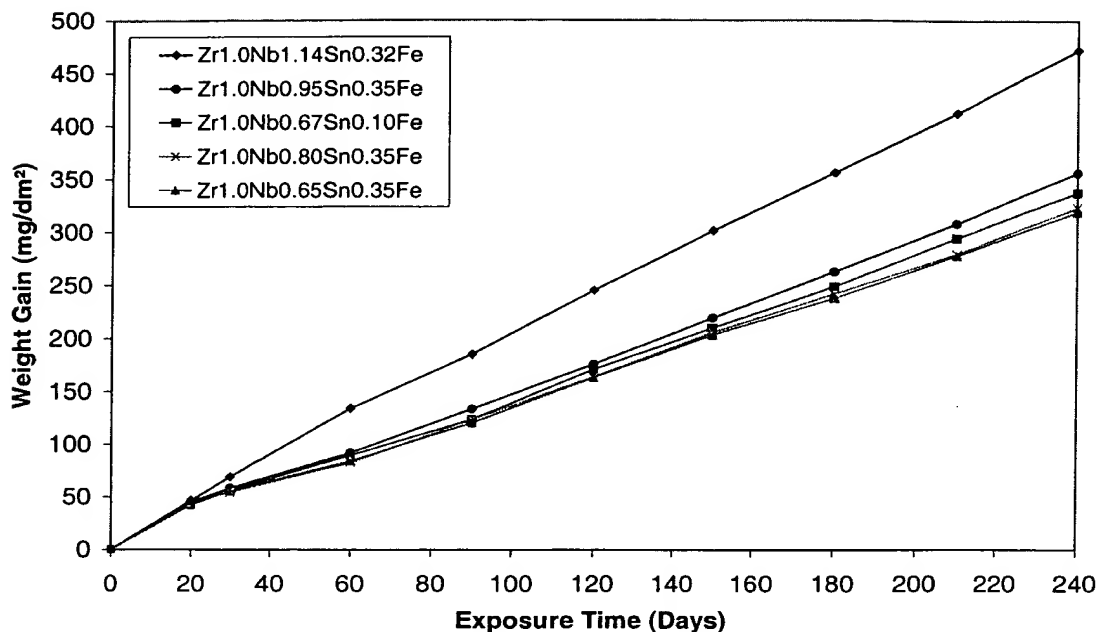


Figure C: Long term autoclave test results of coupons in steam at 688 K.

Based on the results from the 633 K 70 ppm lithiated water, 633 K pure water and 700 K steam tests presented earlier along with the 688 K steam test presented here, the inventors conclude that the Sn concentration should be within a rather narrow region, 0.65-0.85 wt%. The inventors, further, conclude that the Fe concentration should be 0.3-0.6 wt%, where the lower limit is chosen to secure good corrosion resistance while the upper limit is chosen to minimize potential fabrication issues, i.e., secure a good production yield.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Västerås, Sweden, 26 April 2005

Magnus Limbäck